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Automatic detection of rock outcrops on vegetated and moderately cultivated areas

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State-of-the-art applications in various earth science domains shows that different classification methods are playing an increasingly important role in mapping due to their improving accuracy. However, in the field of geological mapping, the exclusive use of morphometric and spectral indices in classification models are still often considered as subsidiary mapping tools. This is particularly true in areas where the surface is covered by vegetation and the soil layer is relatively thick, since in such places geological structures can only be observed at first hand at rock outcrops. The aim of our research is to investigate the automatic mapping of rock outcrops in the Dorog Basin in Hungary, where outdated geological maps are currently being updated. In this research, we applied the random forest classification combined with a wider range of input data including satellite imagery and ecosystem information.

The Dorog Basin, located in northern central Hungary, has a medium-density settlement network, with built-up and cultivated areas alternating with areas of wooded or scrub-covered terrain with rugged topography. The region is tectonically fragmented, where former fluvial erosion is of great importance. In several cases the Mesozoic carbonates, Paleogene limestones or limnic coal sequences outcrop the Quaternary sediments resulting a diverse, although a well identifiable surface. In the 86.86 km^2 study area, the input of the model included 14 morphometrical raster layers derived from SRTM-1, six raster layers with mineral indices derived from Sentinel II, and one ecosystem layer [1], all set to a uniform ~25m resolution. To test the performance of random forest classification in modelling pre-Quaternary formations, we applied two different approaches. In the first one, we used conventional training areas to model pre-Quaternary outcrops, as well as we modelled the physical characteristics of the surface formations. Whereas in the second one, we modelled the pre-Quaternary outcrops and physical characteristics of the surface formations by using randomly selected zones on the study area with around 6000-10000 random training polygons. The randomly generated training polygons were circles of about 1-2 pixels in size around points. The training areas were derived from the former geological map of the Dorog Basin [2]. The importance of input parameters were also observed for further use. A six-fold cross-validation of the selected training areas showed that the two methods were equally accurate, but the automatic processing of randomly selected training areas was faster.

Based on the modelling results, the pre-Quaternary rock outcrops of the area can be determined

with at least 80% confidence using random forest classification. These results will be used in future field mapping, which will also provide a field validation of the method.

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[1] Ecosystem Map of Hungary. DOI: 10.34811/osz.alapterkep

[2] Gidai, L., Nagy, G., & Sipass, S. (1981). Geological map of the Dorog Basin 1: 25 000. [in Hungarian] Geological Institute of Hungary, Budapest.